Reanalyzing the largest optical imaging survey

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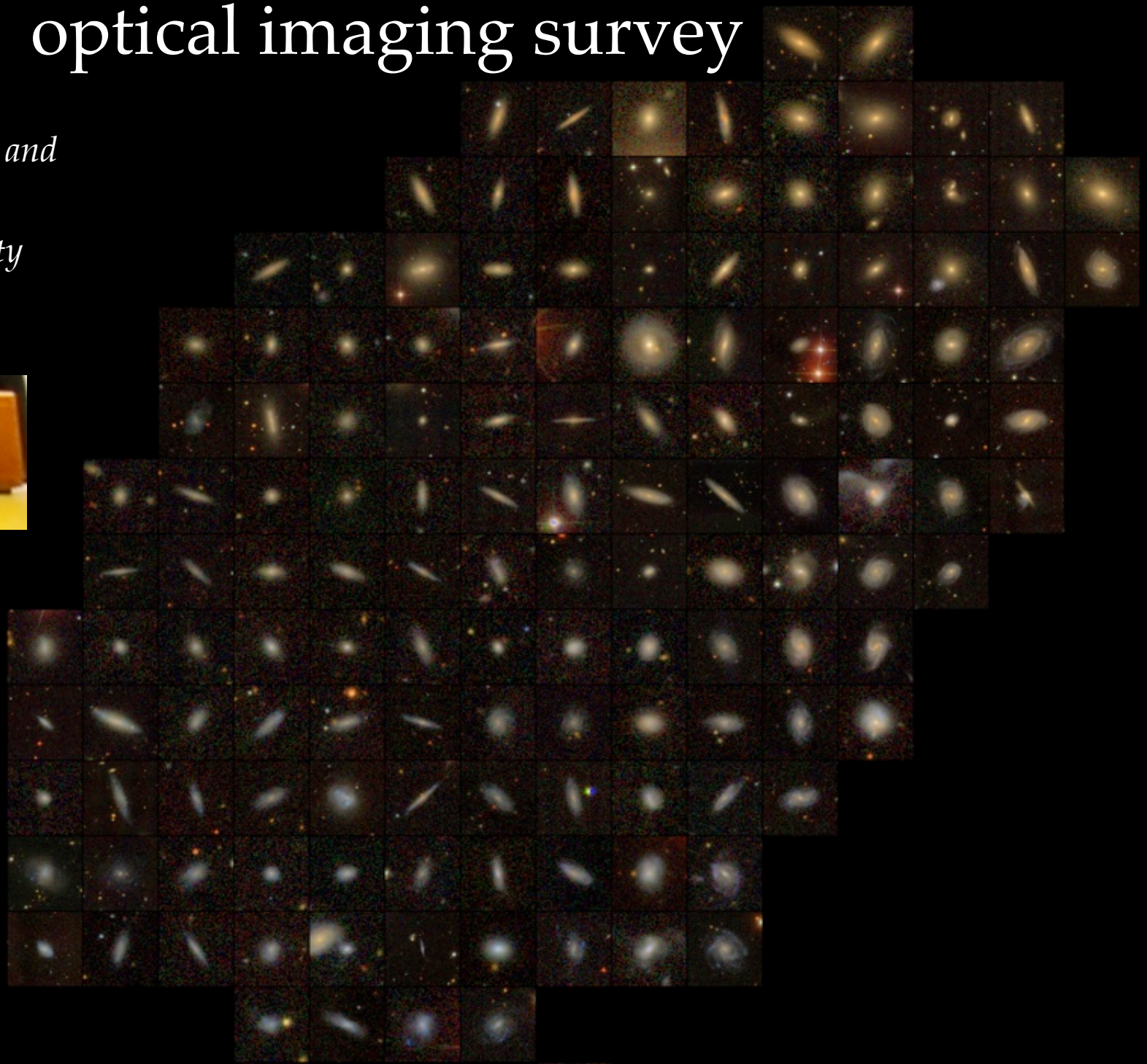
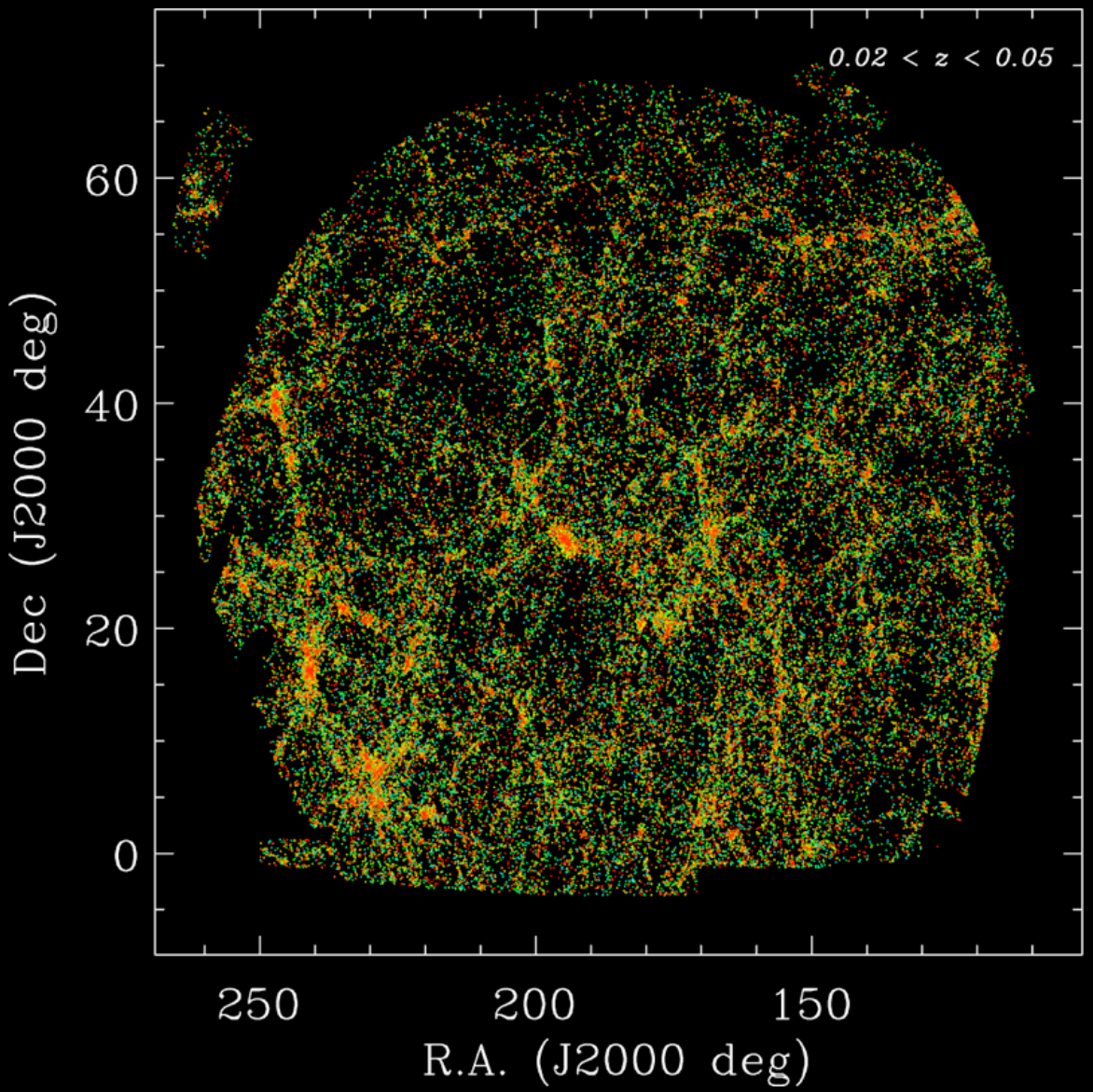
SDSS





Sloan Digital Sky Survey
Data Release 7:

10,000 square degrees
(one-quarter of the entire sky)

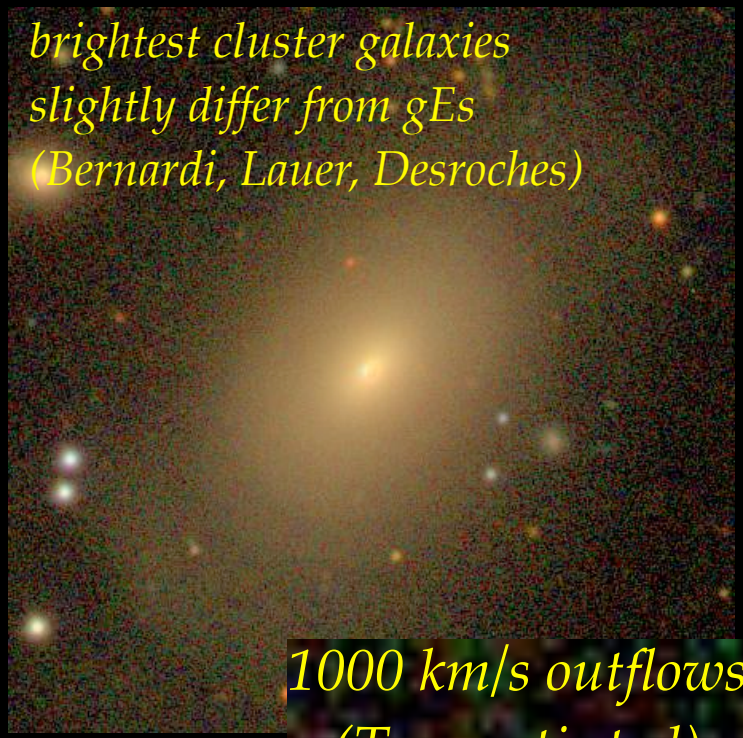
100 million galaxies

0.9 million galaxy redshifts

at left, a LOCAL universe sample,
within a half billion light-years

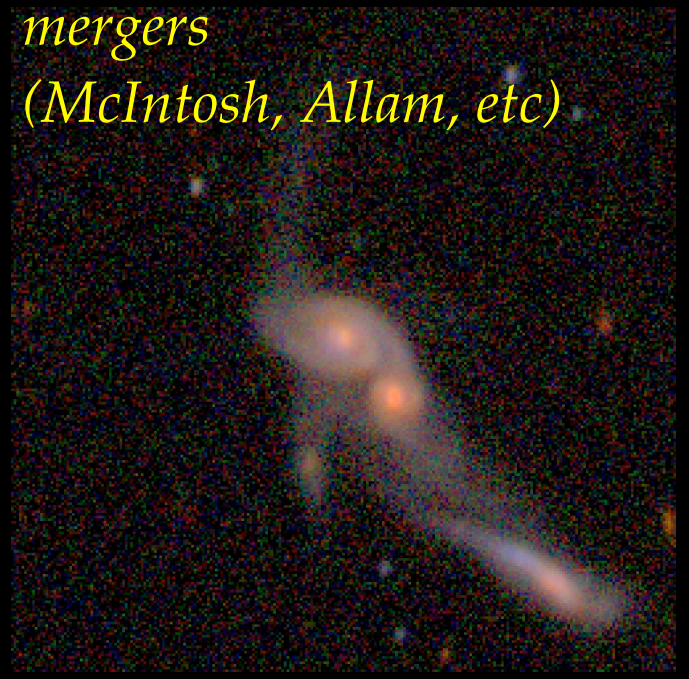
The variety of galaxy structures

brightest cluster galaxies slightly differ from gEs (Bernardi, Lauer, Desroches)



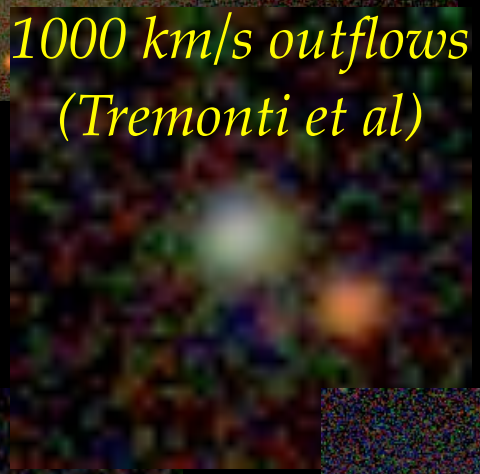
ring galaxies

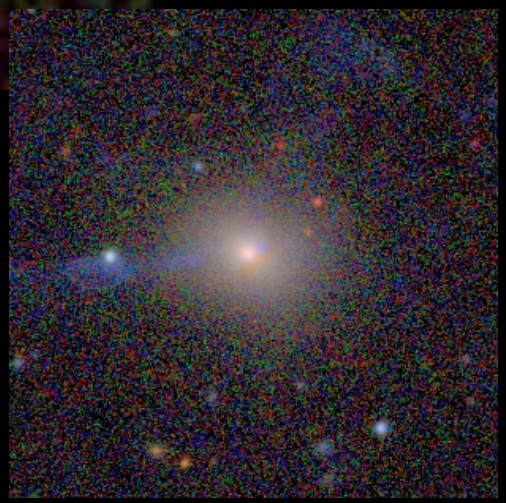
mergers (McIntosh, Allam, etc)



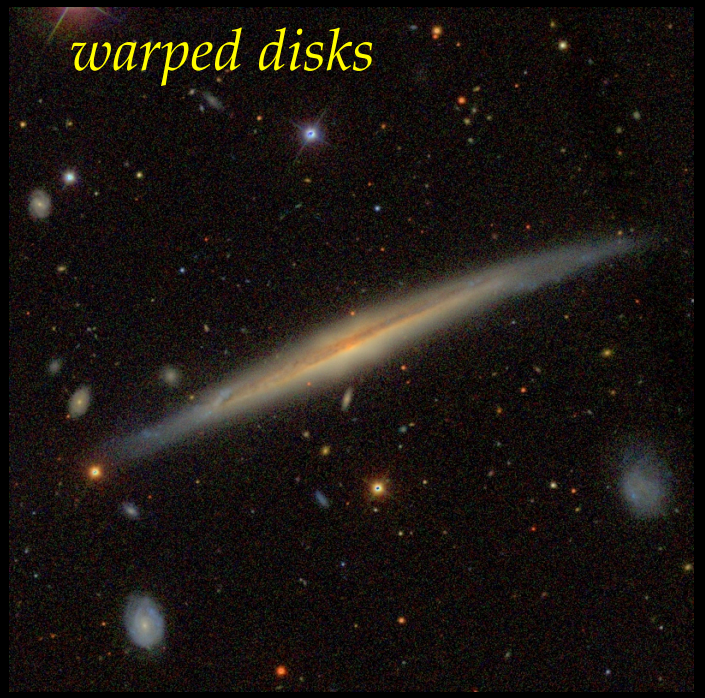
and some are quite weird

1000 km/s outflows (Tremonti et al)





warped disks



Measuring the local sample of galaxies properly

1. *To study the change in the population of galaxies over time, we need a well-measured local sample, which strangely enough does not yet exist.*

2. *Sky-subtraction is a major issue for the largest sample of nearby galaxies (at least, for the ones measured at high enough resolution)*

3. *Simultaneously, we want to analyze ultraviolet imaging over the same area, because distant samples are in the rest-frame ultraviolet (due to the redshift)*

4. *This motivates a new local atlas of galaxies, the "NASA-Sloan Atlas," based on consistently analyzed wide-field ultraviolet, optical, and near-infrared data*

SDSS sky subtraction

A typical SDSS drift scan:
shown is standard survey estimate of the sky level

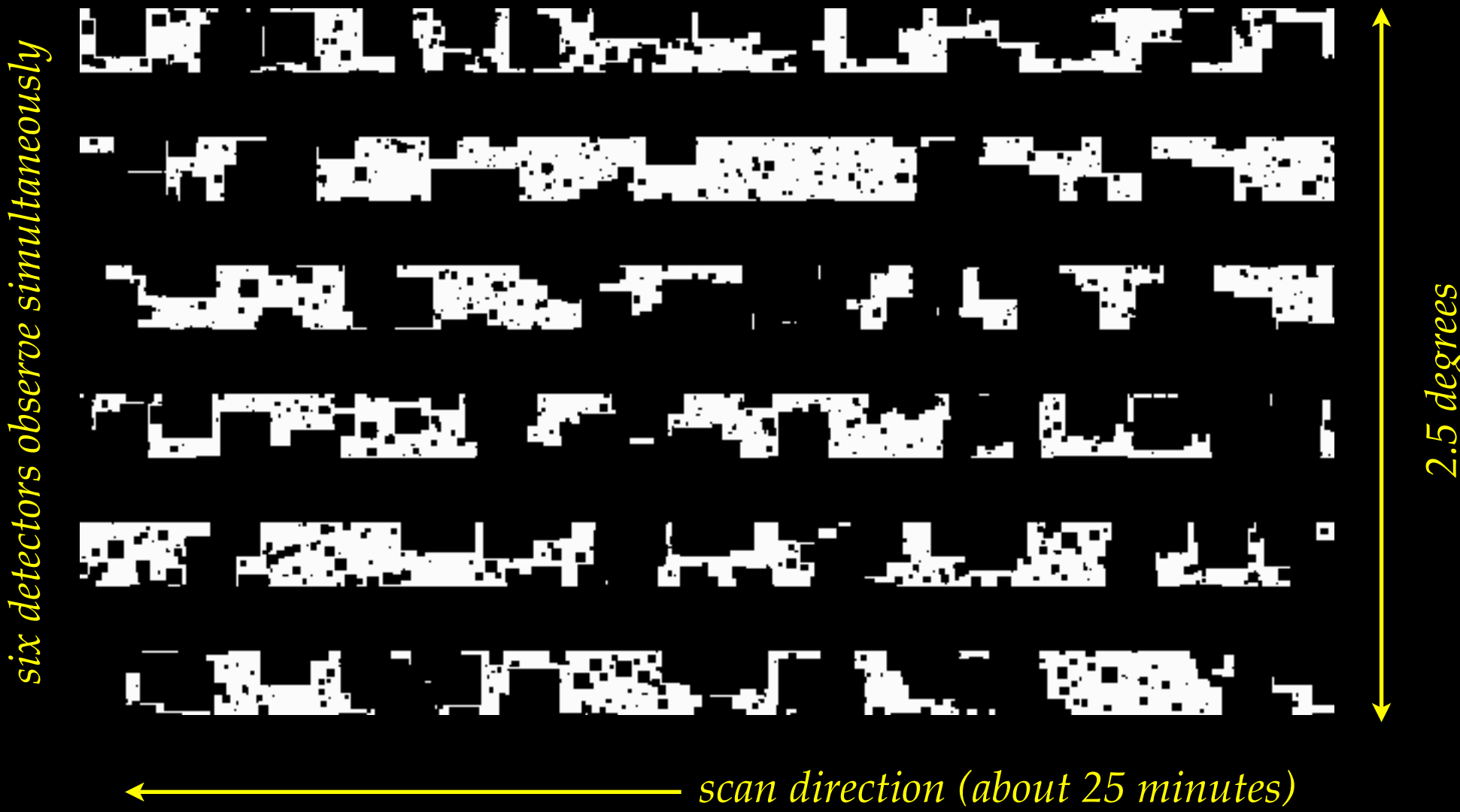
six detectors observe simultaneously

2.5 degrees

scan direction (about 25 minutes)

SDSS sky subtraction

To do a better job, we first mask everything that is conceivably an astronomical source

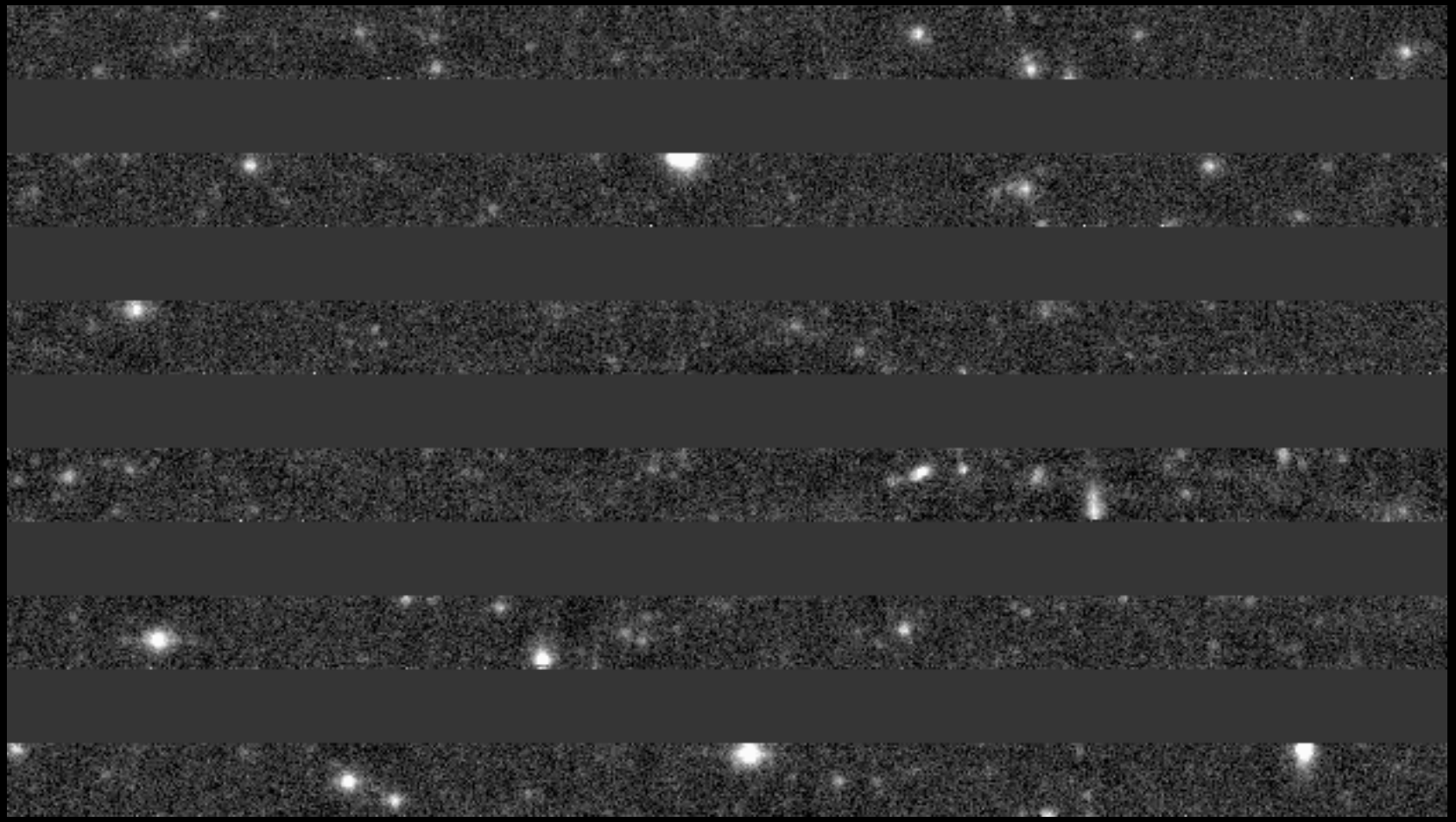


SDSS sky subtraction

Model unmasked pixels with smooth spline,
repeat for 30 Tbytes worth of imaging data

SDSS sky subtraction

After subtraction, most residuals are much less than 1% sky background



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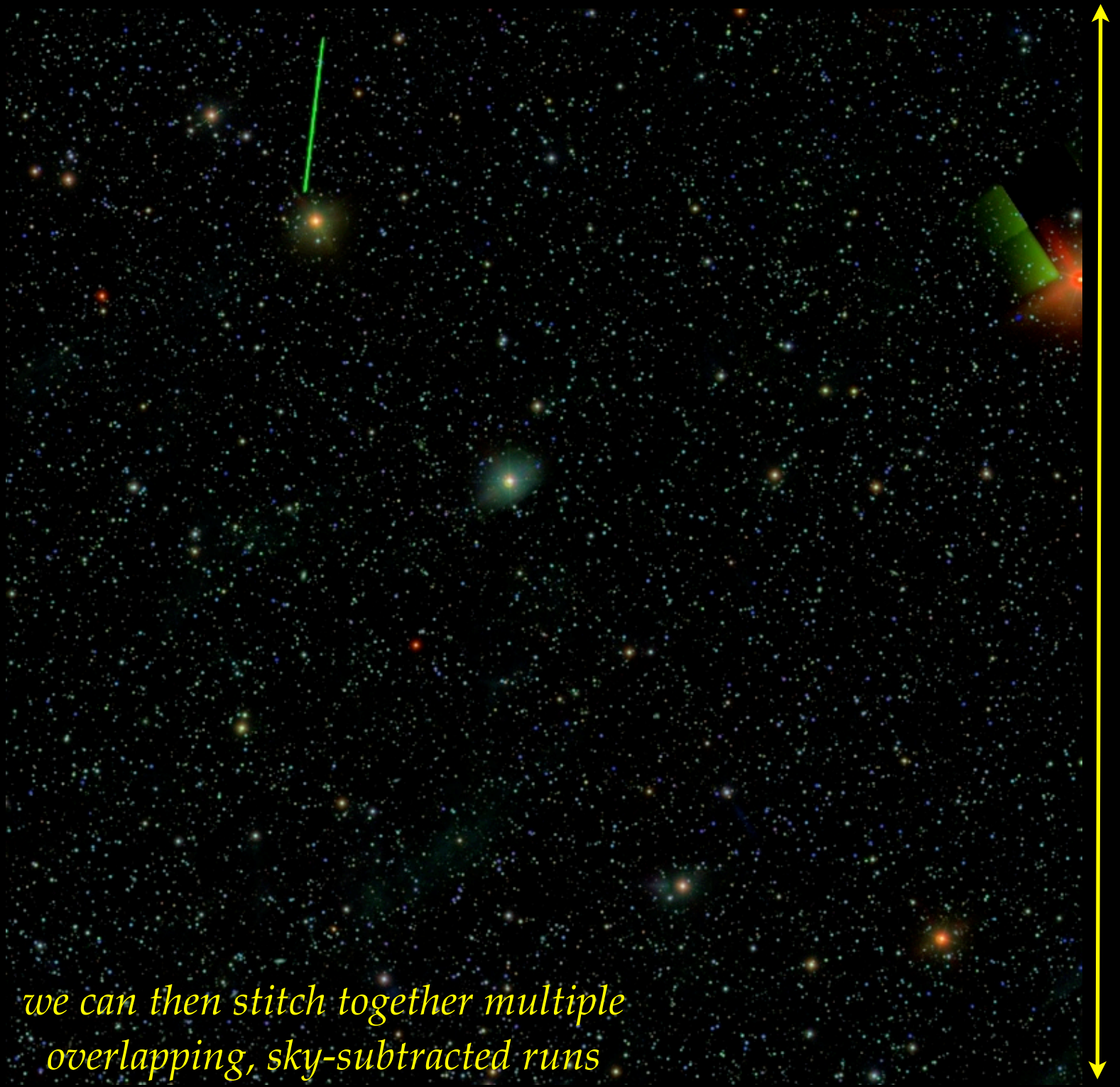
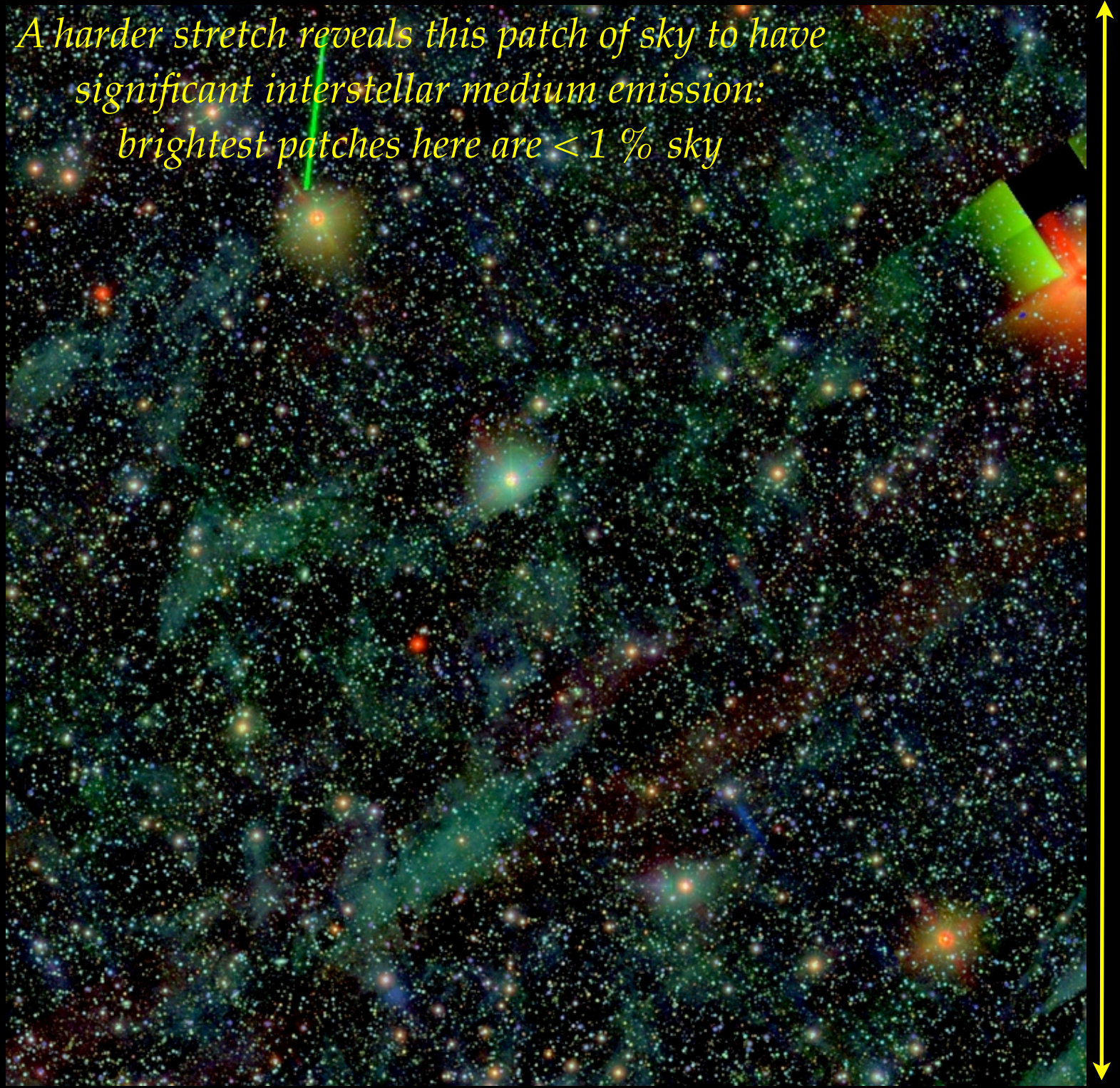
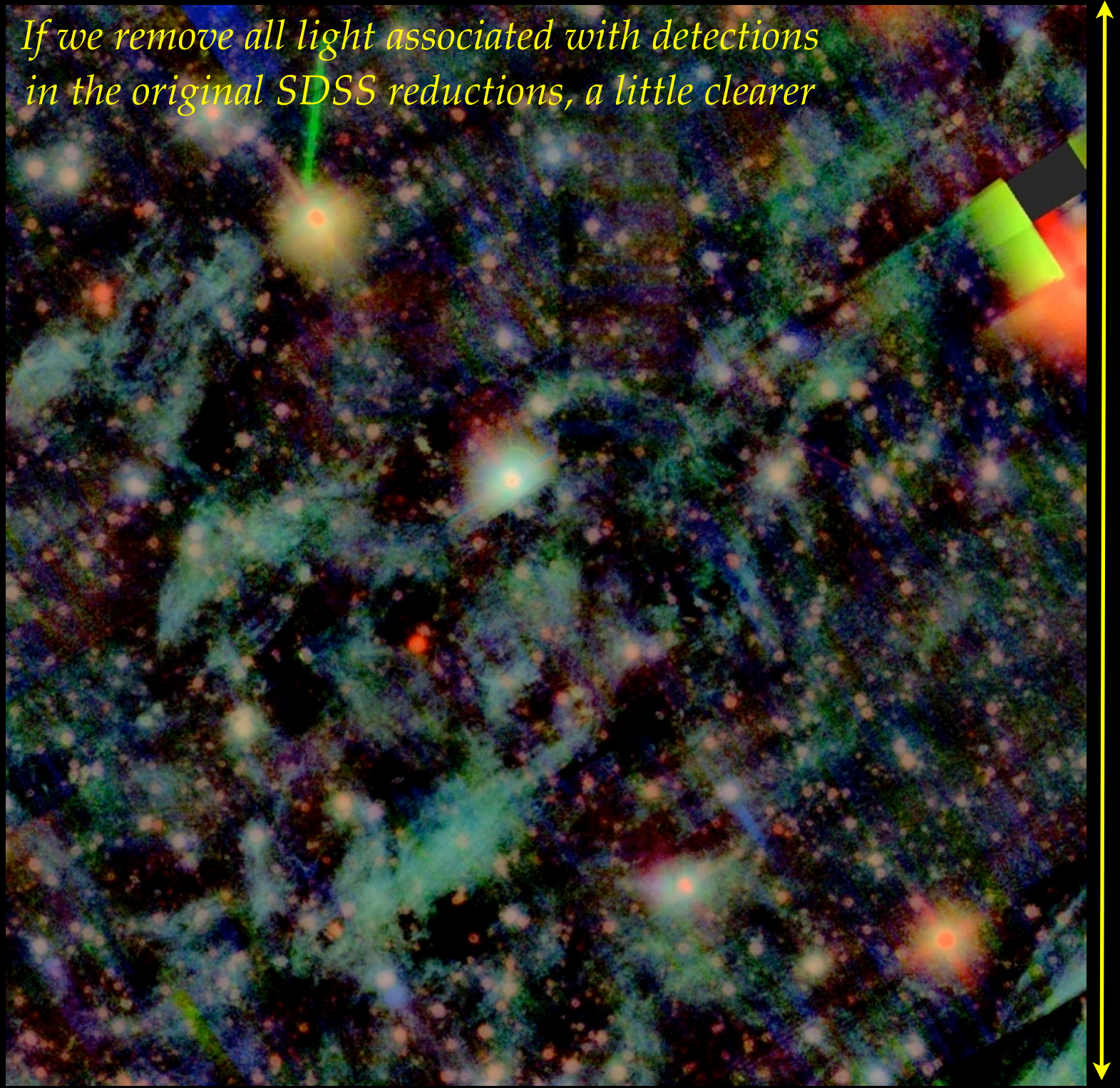
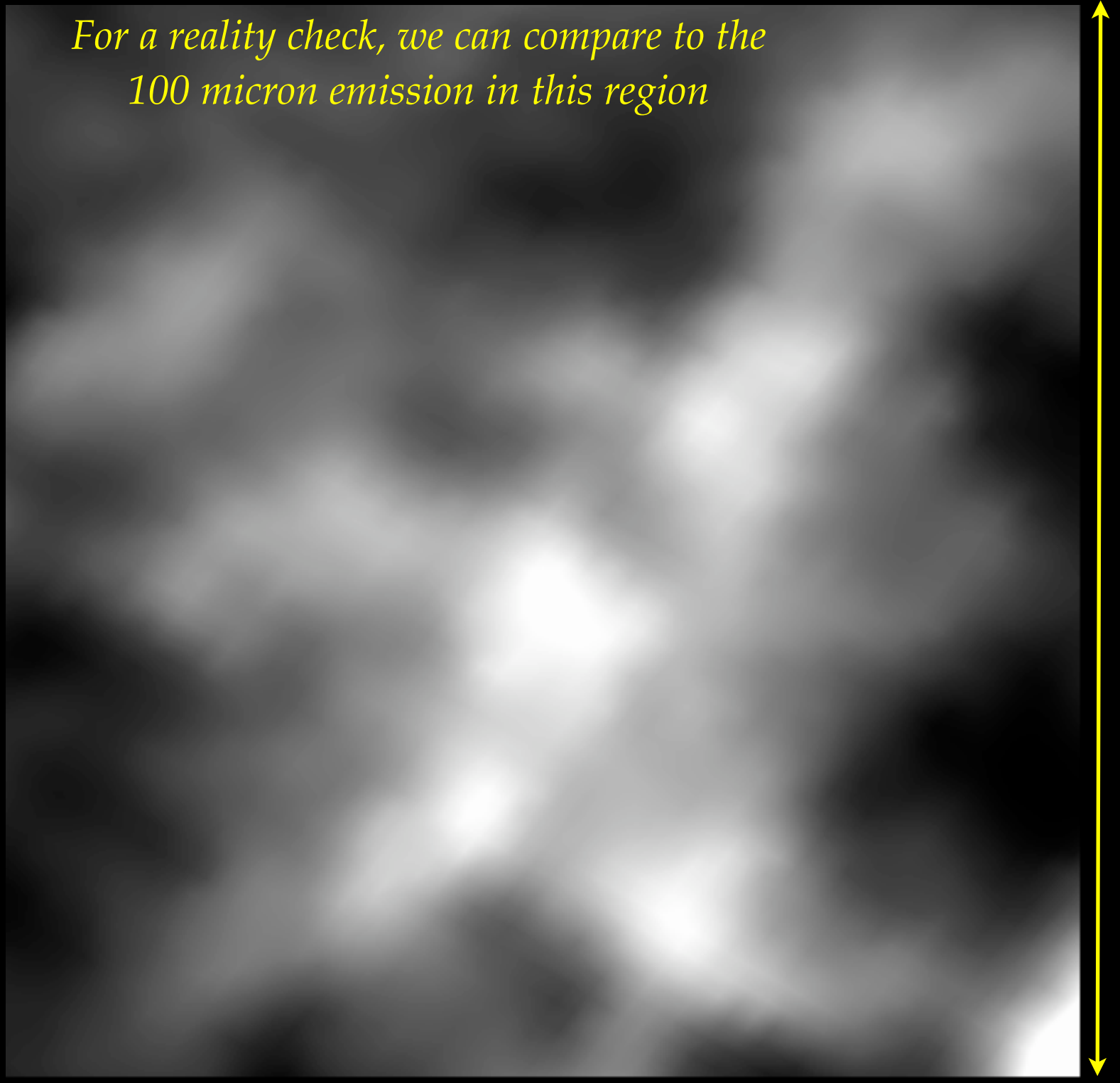

2 degrees
we can then stitch together multiple
overlapping, sky-subtracted runs

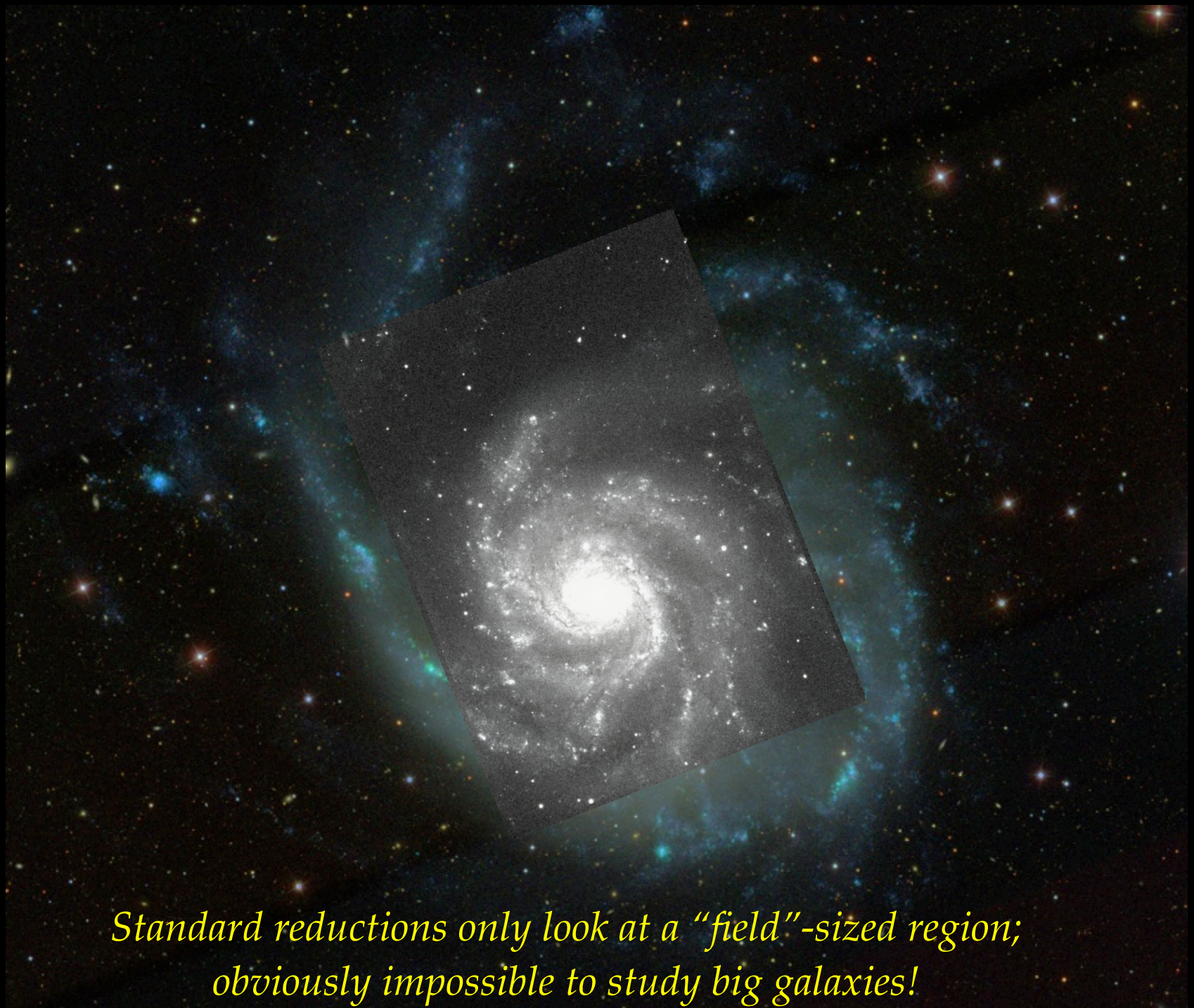

A harder stretch reveals this patch of sky to have
significant interstellar medium emission:
brightest patches here are < 1 % sky
2 degrees


If we remove all light associated with detections
in the original SDSS reductions, a little clearer
2 degrees


For a reality check, we can compare to the
100 micron emission in this region
2 degrees

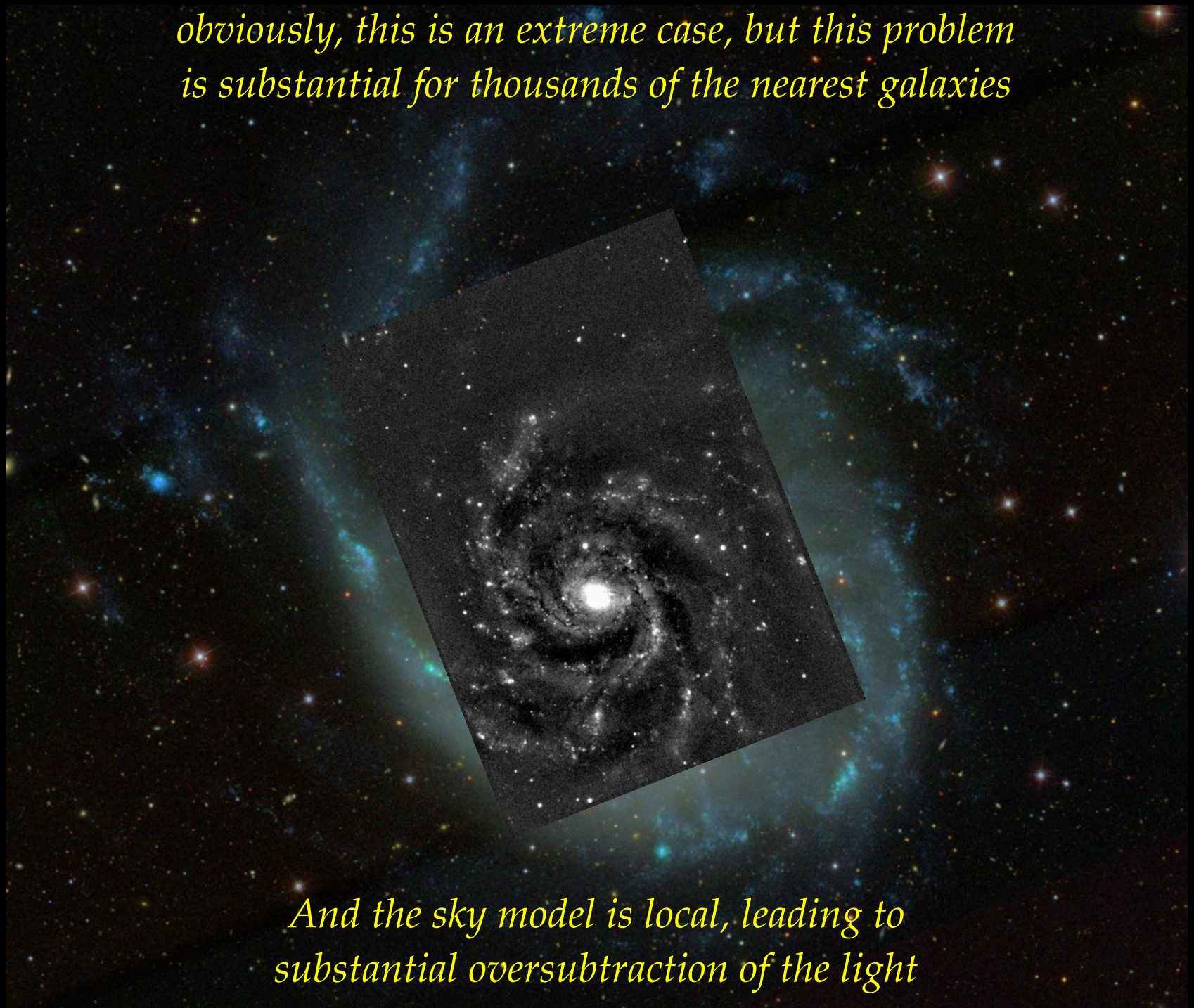
M101 image

M101 image



Standard reductions only look at a "field"-sized region;
obviously impossible to study big galaxies!

M101, with standard sky subtraction



The NASA-Sloan Atlas

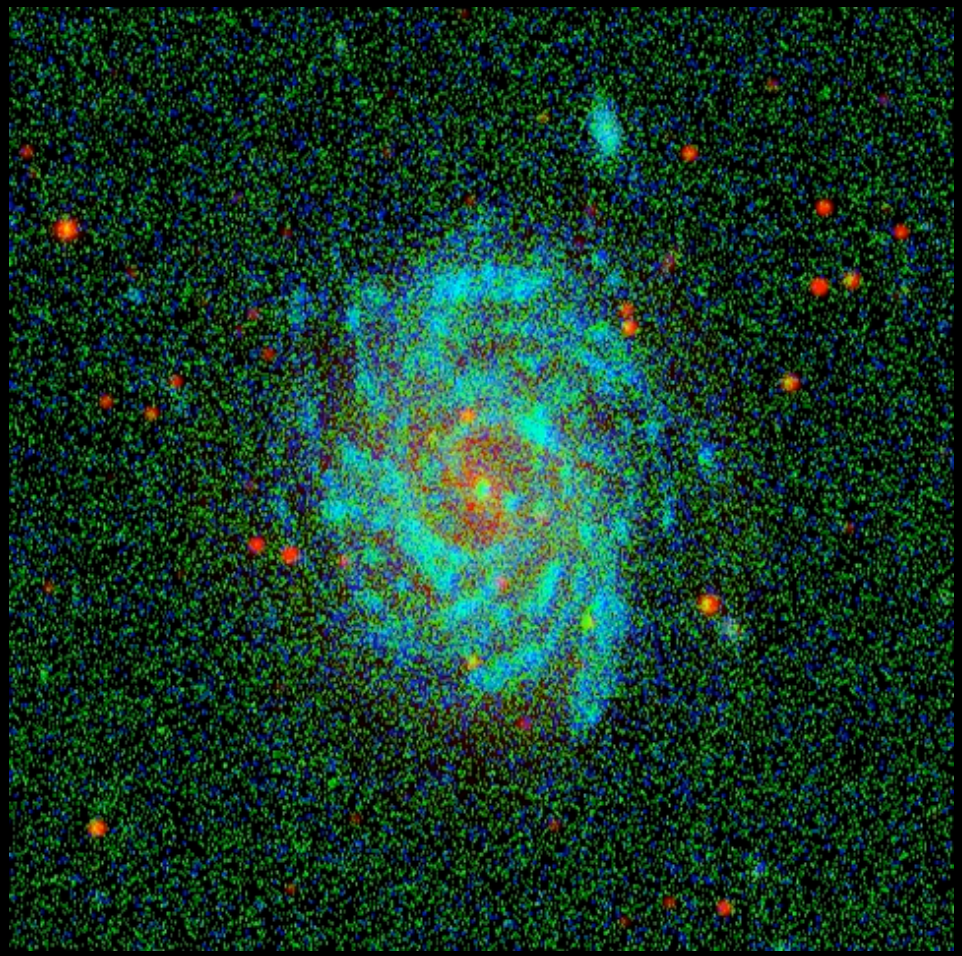
1. *Sky-subtracted SDSS (optical), GALEX (ultraviolet) and 2MASS (near-infrared) images*

2. *Sample of 100,000 galaxies within 500 million lightyears*

3. *Simultaneously deblend and measure in multiple bands, at multiple resolutions*

4. *Do fun science with the results!*

GALEX-SDSS images (ultraviolet plus optical)



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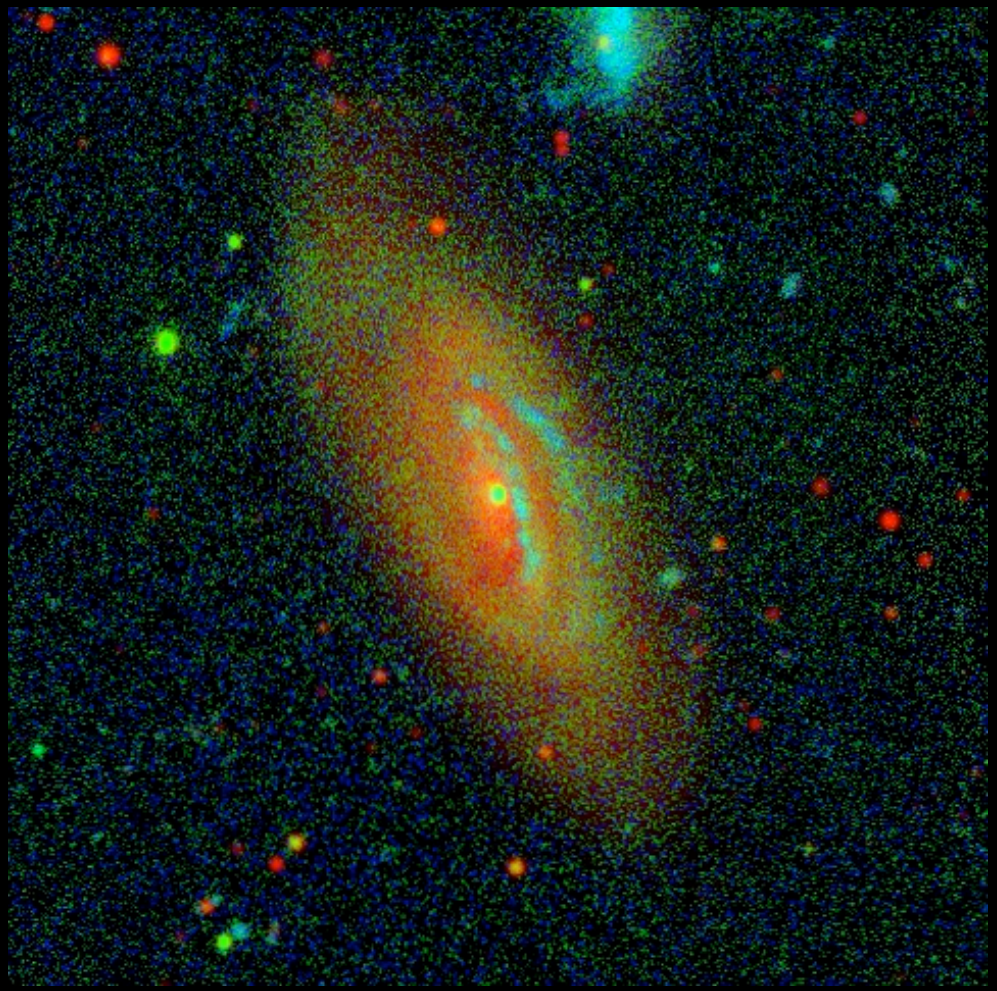

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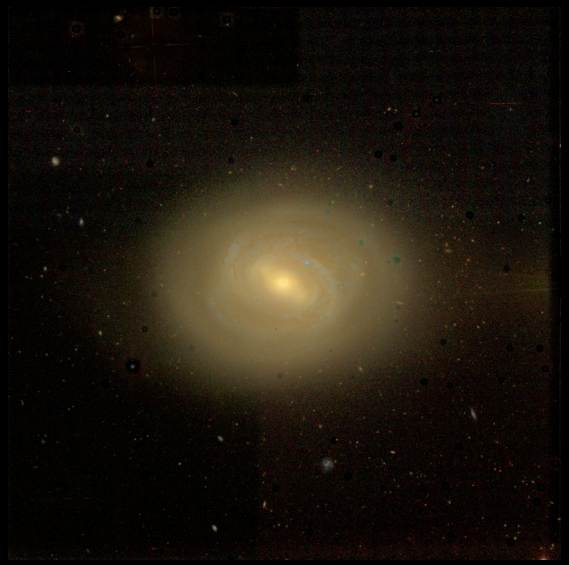
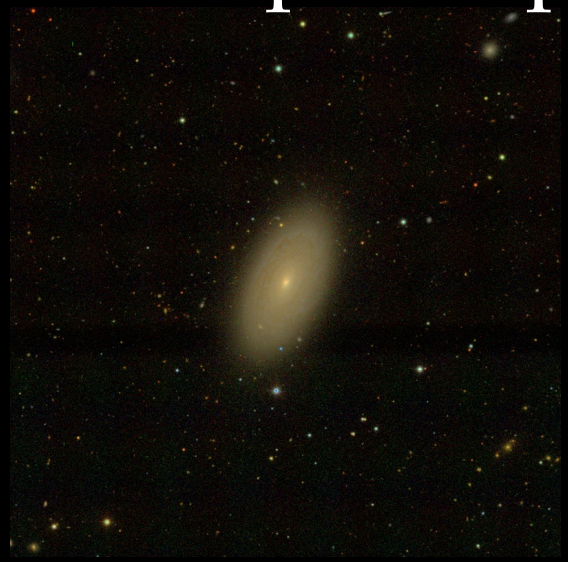
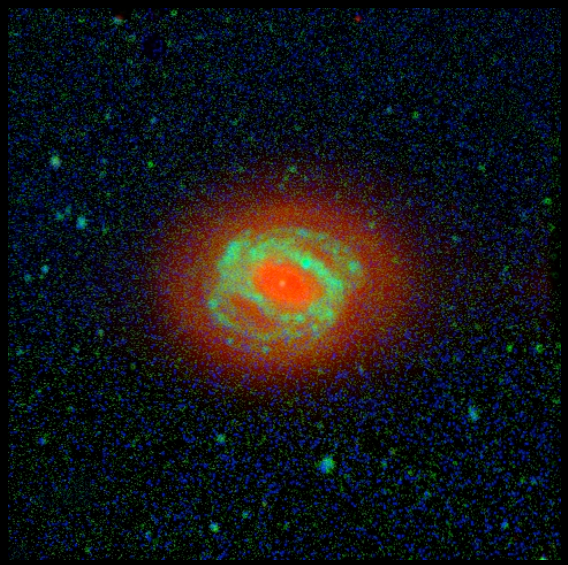
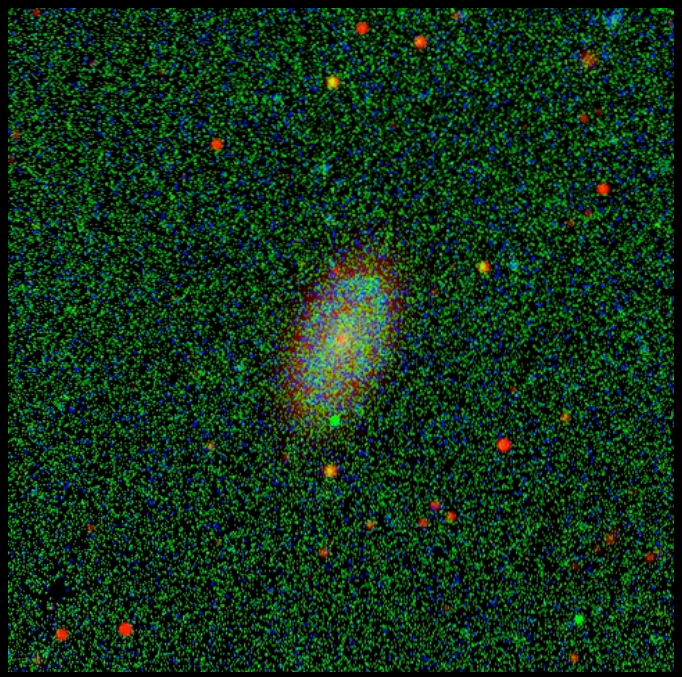
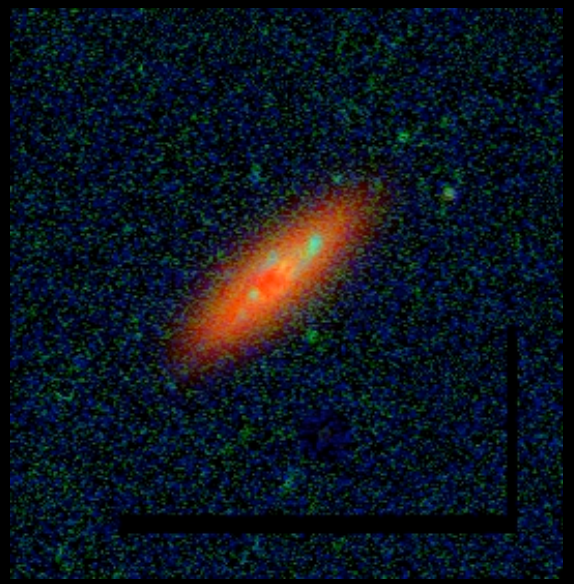
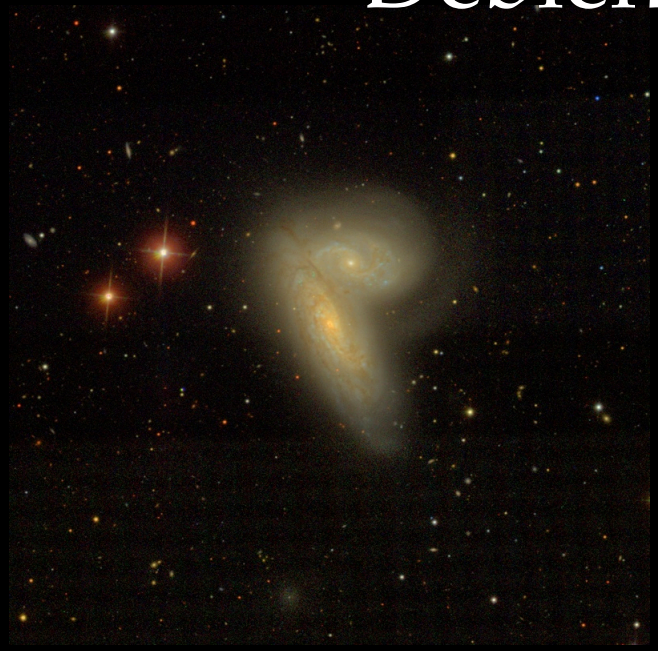
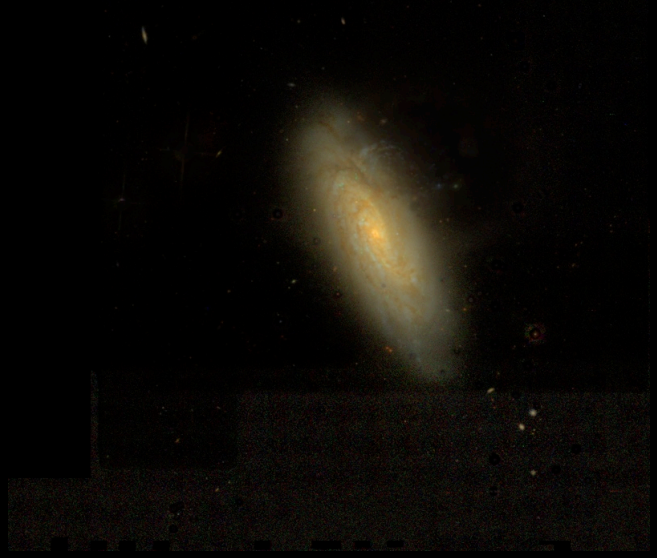
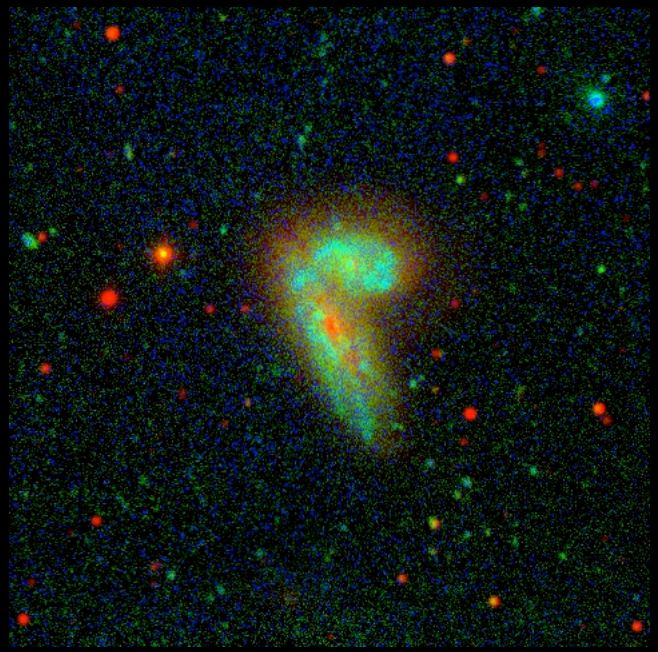
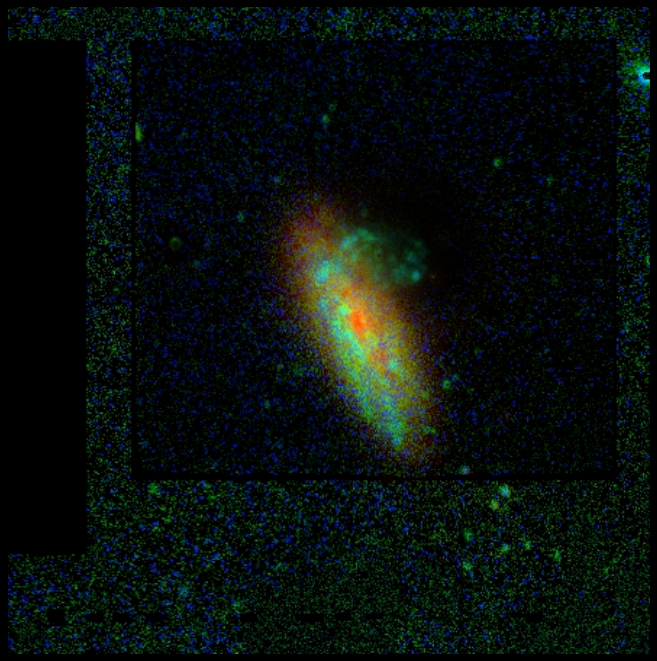
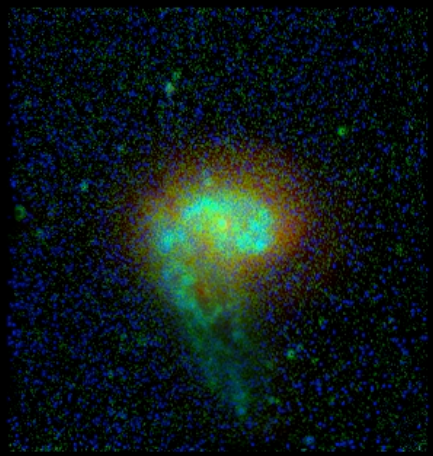



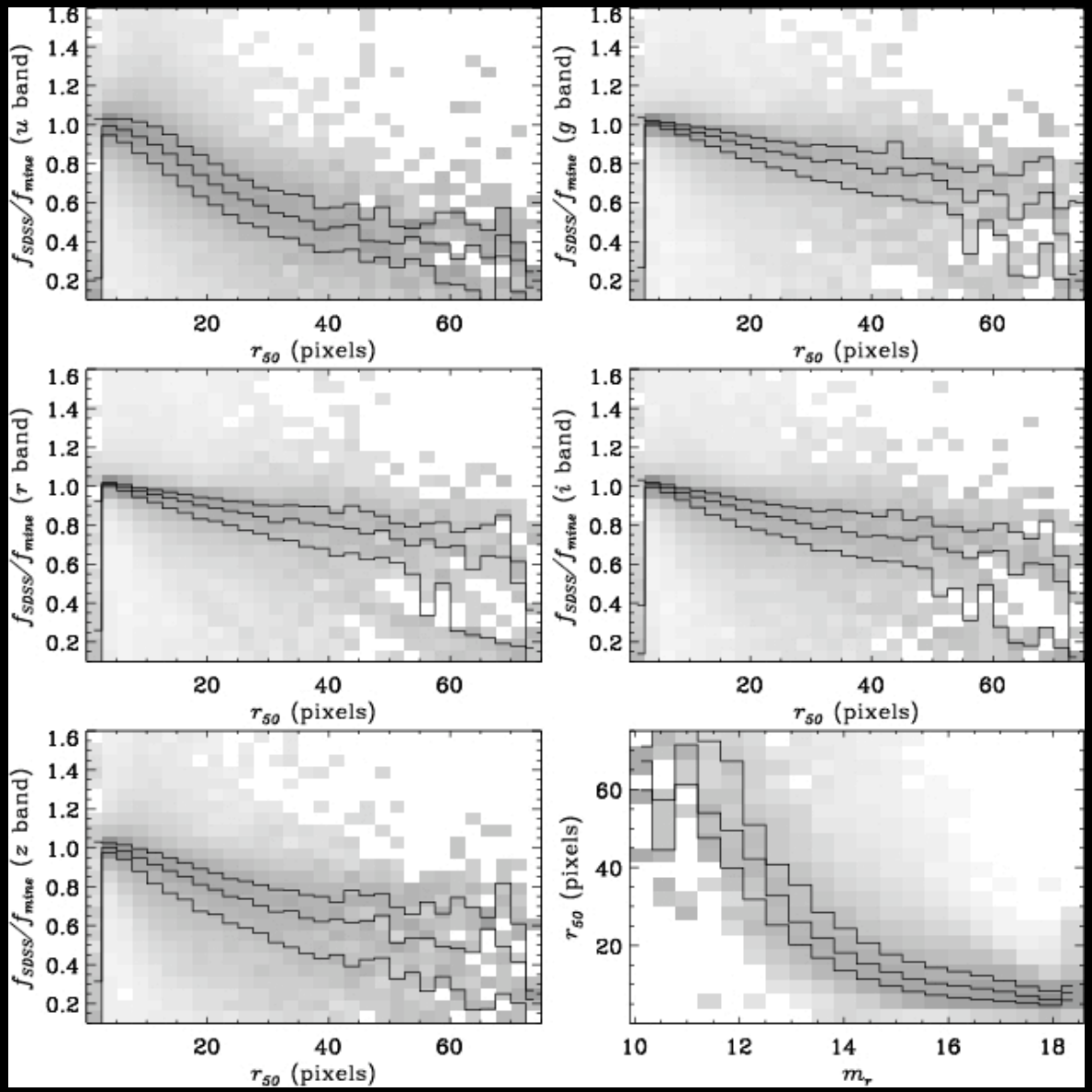
“Deblending” overlapping objects

After reanalysis, significantly improved measurements!

ratio of SDSS flux to our flux



size of galaxy

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